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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention is a luminescent device using the electroluminescence (EL) which emits light by pouring of the electric charge from an electrode, and relates to the organic electroluminescence (EL) element using an organic thin film as a luminous layer.

[0002]

[Description of the Prior Art]In recent years, to use the organometallic complex which shows phosphorescence luminescence for the excitation triplet state which was hardly able to be used also near a room temperature as a policy of efficient-izing of an organic EL device as a luminescent material is tried. For example, in Appl. Phys. Lett., 75 and 4 (1999), a U.S. Pat. No. 6,310,360 item, and JP,2001-313178,A, A tris(2-phenylpyridine) iridium (III) complex is indicated and it is reported that the organic EL device which used this for the dopant of the luminous layer shows 8% of an external quantum yield. In J. Am.Chem. Soc., 123 and 4304 (2001), and JP,2001-247859,A. The iridium (III) complex containing a diketone ligand and nitrogen-containing heterocycle ligand other than an alt.metal-ized ligand is indicated, and it is reported that an external quantum yield with an expensive organic EL device which used these for the dopant of the luminous layer is shown.

[0003]However, as for the tris(2-phenylpyridine) iridium (III) complex indicated in Appl. Phys. Lett., 75,4 (1999), a U.S. Pat. No. 6,310,360 item, and JP,2001-313178,A, the luminescent color is restricted to the green chisel. J. Am. Chem. Soc., 123, 4304 (2001), And although the iridium (III) complex containing the diketone ligand and nitrogen-containing heterocycle ligand other than an alt.metal-ized ligand which are indicated by JP,2001-247859,A shows luminescence to bluish green - orange, its quantum yield of phosphorescence luminescence is not enough, and its stability of a complex is low.

[0004]

[Problem(s) to be Solved by the Invention] Since the purpose of this invention uses a platinum metal as a central metal preferably and it has a sulfur-metallic bond, Intersection between systems to an excitation triplet from an excitation singlet is performed efficiently, and a metal complex with very good stability is used as a luminescent material, It excels in the preservation and driving stability at the time of an elevated temperature, and luminous efficiency is high, and the current density dependency of luminous efficiency is small, and it is providing the organic electroluminescence element the life-span of [ organic electroluminescence element ] can be extended.

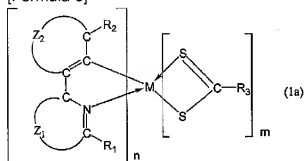
[0005]

[Means for Solving the Problem] The above-mentioned purpose is attained by following this invention.

(1) An organic electroluminescence element which has an organic layer which contains a compound expressed with a formula (1a) or a formula (1b) in an organic electroluminescence element which has the anode and the negative pole and has an organic layer which contains a luminous layer at least between this anode and negative pole.

[0006]

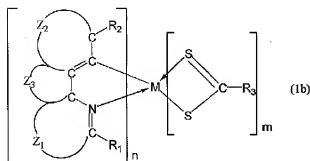
[Formula 6]



[0007] In [type (1a), M expresses the metal or the rare earth element which can take the valence more than bivalence. By expressing the atomic group for completing the nitrogen-containing heterocycle of 5 members or 6 members,  $Z_2$  may express the atomic group for completing the ring of 5 members or 6 members, or heterocycle, and these rings may have a substituent, and  $Z_1$  may have a condensed ring.  $R_1$ ,  $R_2$ , and  $R_3$ , Respectively A hydrogen atom, a halogen atom, a carboxy group, a hydroxy group, A cyano group, an alkyl group, an aralkyl group, an alkenyl group, an aryl group, an amino group, an alkoxy group, an aryloxy group, an acyl group, an acyloxy group, an alkoxycarbonyl group, an aryloxy carbonyl group, or a heterocycle group is expressed. m and n are one or more integers, respectively, and m+n is in agreement with the valence of M. ]

[0008]

[Formula 7]



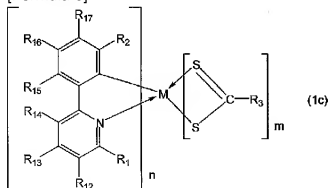
[0009] In [type (1b), M expresses the metal or the rare earth element which can take the valence more than bivalence.  $Z_1$  expresses the atomic group for completing the nitrogen-containing heterocycle of 5 members or 6 members, and  $Z_2$  and  $Z_3$ , By expressing the atomic group for completing the ring of 5 members or 6 members, or heterocycle, respectively, these rings form the condensed ring of each other, and it may have a substituent further, and may have a condensed ring.  $R_1$ ,  $R_2$ , and  $R_3$ , Respectively A hydrogen atom, a halogen atom, a carboxy group, a hydroxy group, A cyano group, an alkyl group, an aralkyl group, an alkenyl group, an aryl group, an amino group, an alkoxy group, an aryloxy group, an acyl group, an acyloxy group, an alkoxycarbonyl group, an aryloxy carbonyl group, or a heterocycle group is expressed. m and n are one or more integers, respectively, and m+n is in agreement with the valence of M. ]

(2) An organic electroluminescence element of the above (1) whose compound expressed with a formula (1a) or a formula (1b) is a platinum metal complex whose M is a ruthenium, rhodium, palladium, osmium, iridium, or platinum in a formula (1a) or a formula (1b).

(3) An organic electroluminescence element of the above (2) to which said platinum metal complex is expressed with a formula (1c), a formula (1d), or a formula (1e).

[0010]

[Formula 8]

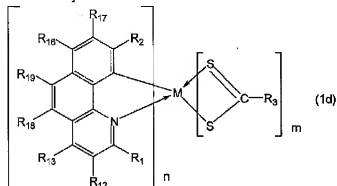


[0011] In [type (1c), M expresses a ruthenium, rhodium, palladium, osmium, iridium, or platinum.  $R_1 - R_3$  and  $R_{12} - R_{17}$ , Respectively A hydrogen atom, a halogen atom, a carboxy

group, a hydroxy group, A cyano group, an alkyl group, an aralkyl group, an alkenyl group, an aryl group, An amino group, an alkoxy group, an aryloxy group, an acyl group, an acyloxy group, An alkoxycarbonyl group, an aryloxy carbonyl group, or a heterocycle group is expressed, two pieces which two pieces which  $R_1$  and  $R_{12} - R_{14}$  adjoin or  $R_2$  and  $R_{15} - R_{17}$  adjoin may combine with each other, and they may form a ring.  $m$  and  $n$  are one or more integers, respectively, and  $m+n$  is in agreement with the valence of  $M$ . ]

[0012]

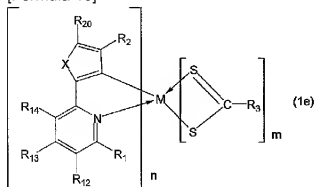
[Formula 9]



[0013]In [type (1d),  $M$  expresses a ruthenium, rhodium, palladium, osmium, iridium, or platinum.  $R_1 - R_3$ ,  $R_{12}$ ,  $R_{13}$  and  $R_{16} - R_{19}$ , Respectively A hydrogen atom, a halogen atom, a carboxy group, a hydroxy group, A cyano group, an alkyl group, an aralkyl group, an alkenyl group, an aryl group, An amino group, an alkoxy group, an aryloxy group, an acyl group, an acyloxy group, An alkoxycarbonyl group, an aryloxy carbonyl group, or a heterocycle group is expressed, it may combine with each other and two pieces which  $R_1$ ,  $R_2$ ,  $R_{12}$ ,  $R_{13}$  and  $R_{16} - R_{19}$  adjoin may form a ring.  $m$  and  $n$  are one or more integers, respectively, and  $m+n$  is in agreement with the valence of  $M$ . ]

[0014]

[Formula 10]



[0015]In [type (1e),  $M$  expresses a ruthenium, rhodium, palladium, osmium, iridium, or

platinum.  $R_1 - R_3$  and  $R_{12} - R_{14}$ , and  $R_{20}$ , Respectively A hydrogen atom, a halogen atom, a carboxy group, a hydroxy group, A cyano group, an alkyl group, an aralkyl group, an alkenyl group, an aryl group, An amino group, an alkoxy group, an aryloxy group, an acyl group, an acyloxy group, An alkoxy carbonyl group, an aryloxy carbonyl group, or a heterocycle group is expressed, and two pieces which  $R_1$  and  $R_{12} - R_{14}$  adjoin or  $R_2$ , and  $R_{20}$  may combine with each other, and may form a ring. X expresses a hetero atom. m and n are one or more integers, respectively, and m+n is in agreement with the valence of M. ]

(4) One organic electroluminescence element of above-mentioned (1) - (3) in which the organic layer containing the compound expressed with a formula (1a) or a formula (1b) is a luminous layer, and this luminous layer contains the compound which carries out a dopant and is expressed with said formula (1a) or a formula (1b).

(5) An organic electroluminescence element with a larger value than the minimum excitation triplet energy of a compound which contains an organic compound as a host material of said luminous layer and by which the minimum excitation triplet energy of this organic compound is expressed with said formula (1a) or a formula (1b) of the above (4).

(6) Said luminous layer contains a further different organic compound from a compound expressed with said host material, said formula (1a), or a formula (1b), An organic electroluminescence element with a value with the larger minimum excitation triplet energy of this organic compound than the minimum excitation triplet energy of a compound expressed with said formula (1a) or a formula (1b) of the above (5).

(7) One organic electroluminescence element of above-mentioned (1) - (3) which has a luminous layer containing a fluorescent luminescence organic compound which an organic layer containing a compound expressed with a formula (1a) or a formula (1b) is a luminous layer, adjoins this luminous layer, and is different from this.

[0016]

[Embodiment of the Invention] Hereafter, this invention is explained in detail. The organic electroluminescence element (henceforth an "organic EL device") of this invention has the anode and the negative pole, the organic layer of at least one layer is provided between the anode and the negative pole, and the luminous layer of at least one layer is contained in this organic layer.

[0017] The organic layer in this case and the metal complex (preferably platinum metal complex) of the compound being expressed with a formula (1a) or a formula (1b) to a luminous layer speaking concretely, contain as luminescent materials.

[0018] Such a metal complex is an alt. metal-ized metal complex configured to metal (preferably platinum metal) with two sulfur including dithiocarboxylic acid thru/or its derivative as a ligand. Here, in the ring completed by  $Z_2$ , alt. metal-ization means the reaction which

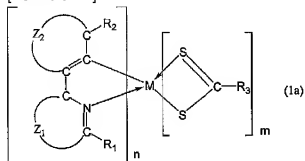
generates the chelate ring in which C-H combination of the ortho position includes a metal-carbon to carbon bond by an intramolecular reaction to the connecting position of the substituent which has a donor atom of ligand.

[0019] Therefore, since such a metal complex has a platinum metal as a central metal preferably and has a sulfur-metallic bond, intersection between systems to an excitation triplet from an excitation singlet is performed efficiently, and its stability is very good. Therefore, the organic EL device using such a metal complex as a luminescent material is excellent in the preservation and driving stability at the time of an elevated temperature, and its luminous efficiency is high, and its current density dependency of luminous efficiency is small, and the life-span of [ it ] can be extended.

[0020] Hereafter, this invention is explained centering on a platinum metal complex among the metal complexes expressed with a formula (1a) or a formula (1b).

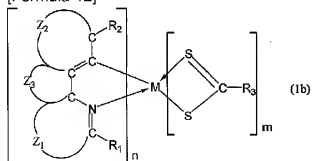
[0021]

[Formula 11]



[0022]

[Formula 12]



[0023] It is the metal or the rare earth element which M expresses a central metal and can take the valence more than bivalence in a formula (1a) and a formula (1b). It is a platinum metal preferably chosen from a ruthenium (Ru), rhodium (Rh), palladium (Pd), osmium (Os), iridium (Ir), and platinum (Pt).

[0024]  $R_1 - R_3$  A hydrogen atom, a halogen atom, a carboxy group, A hydroxy group, a cyano group, an alkyl group, an aralkyl group, an alkenyl group, an aryl group, an amino group, an

alkoxy group, an aryloxy group, an acyl group, an acyloxy group, an alkoxycarbonyl group, an aryloxy carbonyl group, or a heterocycle group is expressed.

[0025]Fluoride, chlorine, bromine, iodine, etc. are mentioned as a halogen atom expressed with  $R_1 - R_3$ .

[0026]As an alkyl group expressed with  $R_1 - R_3$ , it may have substituents (for example, halogen atom etc.) also in no replacing, and may have branching also by straight chain shape, or may be annular, and, as for a total carbon number, it is preferred that it is 1-10. For example, methyl, ethyl, n-propyl, isopropyl, n-butyl, Isobutyl, s-butyl, t-butyl, n-pentyl, isopentyl, neopentyl one, t-pentyl, cyclohexyl, methyl fluoride, a methyl chloride, trifluoromethyl, pentafluoroethyl, etc. are mentioned.

[0027]As an aralkyl group expressed with  $R_1 - R_3$ , it could replace, or may have a substituent, and it is preferred that they are the total carbon numbers 7-20. For example, benzyl, phenethyl, etc. are mentioned.

[0028]As an alkenyl group expressed with  $R_1 - R_3$ , it could replace, or may have substituents (for example, aryl etc.), and it is preferred that they are the total carbon numbers 2-20. For example, vinyl, allyl, propenyl, 2-methyl-1-propenyl, styryl, 2,2-diphenylvinyl, etc. are mentioned.

[0029]As an aryl group expressed with  $R_1 - R_3$ , it could replace, or may have a substituent (for example, alkyl, alkoxy \*\* aryloxy, amino \*\*), and it is preferred that they are the total carbon numbers 6-20. For example, phenyl, tolyl (o-, m-, p-), phenoxyphenyl (o-, m-, p-), biphenyl (2-, 3-, 4-), naphthyl, diphenyl aminophenyl, acetoxypheyl, acetylphenyl, etc. are mentioned.

[0030]As an amino group expressed with  $R_1 - R_3$ , it could replace, or may have substituents (for example, alkyl, an aralkyl, aryl, etc.), and, as for a total carbon number, it is preferred that it is 0-20. For example, amino \*\* methylamino, dimethylamino, phenylamino, diphenylamino, benzylamino, dibenzylamino, ditolylamino, etc. are mentioned.

[0031]As an alkoxy group expressed with  $R_1 - R_3$ , What has an alkyl group expressed with above  $R_1 - R_3$  and an aralkyl group is preferred, for example, methoxy and ethoxy \*\* propoxy, isopropoxy, butoxy, isobutoxy, s-butoxy, t-butoxy, benzyloxy one, etc. are mentioned.

[0032]What has an aryl group expressed with above  $R_1 - R_3$  as an aryloxy group expressed with  $R_1 - R_3$  is preferred, for example, phenoxy, methylphenyloxy, 1-naphthyloxy, 2-naphthyloxy, etc. are mentioned.

[0033]As an acyl group expressed with  $R_1 - R_3$ , it could replace or may have a substituent, and a thing of the total carbon numbers 1-20 is preferred, for example, formyl, acetyl, propionyl, butyryl, isobutyryl, valeryl, benzoyl, etc. are mentioned.

[0034]What has an acyl group expressed with above  $R_1 - R_3$  as an acyloxy group expressed with  $R_1 - R_3$  is preferred, for example, acetoxo, benzoyloxy one, etc. are mentioned.

[0035]What has an alkoxy group expressed with above  $R_1 - R_3$  as an alkoxycarbonyl group expressed with  $R_1 - R_3$  is preferred, for example, carbomethoxy, ethoxycarbonyl, etc. are mentioned.

[0036]What has an aryloxy group expressed with above  $R_1 - R_3$  as an aryloxy carbonyl group expressed with  $R_1 - R_3$  is preferred, for example, phenoxy carbonyl etc. are mentioned.

[0037]As a heterocycle group expressed with  $R_1 - R_3$ , a heterocycle group of 5 members which may have a condensed ring further, and 6 members may be preferred, and may have substituents (for example, alkyl, aryl, etc.), and may have aromatic property, and it may not have. For example, thienyl, pyrrolyl, pyrrolidinyl, pyridyl, carbazolyl, phenyl thienyl, etc. are mentioned.

[0038]As nitrogen-containing heterocycle which a formula (1a) and inner (1b)  $Z_1$  express an atomic group for completing nitrogen-containing heterocycle of 5 members or 6 members, and is completed by  $Z_1$ , An aromatic ring may be preferred, and it may have a condensed ring further, for example, there are a pyridine ring, a quinoline ring, an imidazole ring, a thiazole ring, an oxazole ring, a triazole ring, a pyrimidine ring, a pyrazine ring, etc. These rings may have a substituent, for example, a cyano group, an alkyl group, an alkoxy group, an aryl group, an amino group, an acyl group, an aralkyl group, an alkenyl group, an aryloxy carbonyl group, an alkoxycarbonyl group, etc. are mentioned.

[0039]As a ring which a formula (1a) and inner (1b)  $Z_2$  express an atomic group for completing a ring of 5 members or 6 members, or heterocycle, and is completed by  $Z_2$ , An aromatic ring may be preferred, and it may have a condensed ring further, for example, there are the benzene ring, a naphthalene ring, a biphenyl ring, a terphenyl ring, a thiophene ring, a furan ring, a pyrrole ring, a pyrimidine ring, etc. These rings may have a substituent and For example, a halogen atom, an alkyl group, An alkoxy group, an aryl group, a cyano group, a hydroxy group, a heterocycle group, a carboxy group, an alkenyl group, an aryloxy group, an aryloxy carbonyl group, an amino group, an acyl group, an acyloxy group, etc. are mentioned.

[0040]If a position of a single bond between carbon in a formula (1a) and a formula (1b) and a double bond is expedient and it is not theoretically contradictory when a ring completed by  $Z_2$  is the benzene ring, it will not be limited to this position.

[0041]A ring which  $Z_3$  in a formula (1b) expresses an atomic group for completing a ring of 5 members or 6 members or heterocycle, and is completed by  $Z_3$  forms a condensed ring with a

ring completed by a ring and  $Z_2$  which are completed by  $Z_1$ . What has a ring [ be / the same as that of a ring completed by  $Z_2$  / it ] completed by  $Z_3$  is mentioned.

[0042] In a formula (1a) and (1b), as M, as a ring completed by  $Z_1$ , a pyridine ring is preferred, as a ring completed by  $Z_2$ , the benzene ring and a thiophene ring are preferred, and the benzene ring is preferred [ Ir is preferred, and ] as a ring completed by  $Z_3$ . These rings may have a condensed ring and may have a substituent.

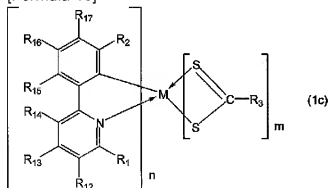
[0043] As  $R_1$ , a hydrogen atom and an aryl group are preferred, and a hydrogen atom and an aryl group are preferred as  $R_2$ , and it is desirable also when forming the benzene ring with a neighboring group as  $R_1$  and  $R_2$ . As  $R_3$ , an alkyl group, an alkoxy group, an alkenyl group, an aryl group, a heterocycle group, an amino group, a hydrogen atom, a halogen atom, a hydroxy group, an acyloxy group, an alkoxycarbonyl group, a cyano group, and an acyl group are preferred, and an alkyl group, an alkoxy group, an alkenyl group, an aryl group, a heterocycle group, and an amino group are especially preferred.

[0044] A formula (1a), inner (1b) m, and n are one or more integers, and m+n is in agreement with a valence of M. As for m, it is preferred that it is 1.

[0045] Also in the above-mentioned platinum metal complex, what is expressed with formula (1c) - (1e) is preferred.

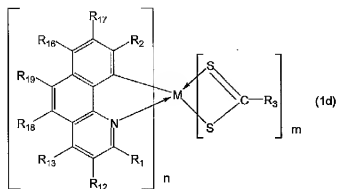
[0046]

[Formula 13]



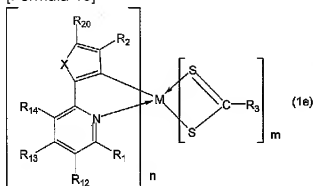
[0047]

[Formula 14]



[0048]

[Formula 15]



[0049] In formula (1c) - (1e), M,  $R_1 - R_3$ , m, and n are synonymous with a formula (1a) and an inner (1b) thing, and  $R_{12} - R_{20}$  are the things of a formula (1a), inner (1b)  $R_1 - R_3$ , and homonymy. In a formula (1e), X expresses a hetero atom.

[0050] Therefore, about M in formula (1c) - (1e),  $R_1 - R_3$ , m, and n, a formula (1a), and an inner (1b) thing and a desirable thing are also the same.

[0051] In a formula (1c), it may combine with each other and the neighboring groups chosen from the neighboring groups chosen from  $R_1, R_{12} - R_{14}$  or  $R_2, R_{15} - R_{17}$  may form a ring. In a formula (1d), it may combine with each other and the neighboring groups chosen from  $R_1, R_{12} - R_{19}$  may form a ring. In a formula (1e), it may combine with each other and the neighboring groups chosen from  $R_1, R_{12} - R_{14}$  or  $R_2$ , and  $R_{20}$  may form a ring.

[0052] In a formula (1c), as  $R_1, R_{12} - R_{14}$ , a hydrogen atom is preferred, and aryl groups, such as phenyl, an amino group, and an acyloxy group are preferred as a substituent, and what forms the benzene ring by neighboring groups is preferred.

[0053] As  $R_2, R_{15} - R_{17}$ , A hydrogen atom is preferred and as a substituent Alkyl groups, such as halogen atoms, such as fluoride, and methyl, Aryl groups, such as alkoxy groups, such as

methoxy, and phenyl, a heterocycle group, a hydroxy group, a cyano group, an alkenyl group, an aryloxy group, a carboxy group, an aryloxy carbonyl group, and an aralkyl group are preferred, and what forms the benzene ring by neighboring groups is preferred.

[0054]In a formula (1d), a hydrogen atom is preferred as  $R_1$ ,  $R_{12}$ , and  $R_{13}$ . As a substituent, aryl groups, such as alkyl groups, such as methyl, and phenyl, an aralkyl group, an alkenyl group, and an aryloxy carbonyl group are preferred, and what forms the benzene ring by neighboring groups is preferred.

[0055]As  $R_2$ ,  $R_{16}$ , and  $R_{17}$ , a hydrogen atom is preferred, and aryl groups, such as alkoxy groups, such as halogen atoms, such as fluoride, and methoxy, and phenyl, an amino group, a carboxy group, an acyl group, and an acyloxy group are preferred as a substituent, and what forms the benzene ring by neighboring groups is preferred.

[0056]As  $R_{18}$  and  $R_{19}$ , a hydrogen atom is preferred, and aryl groups, such as phenyl, a cyano group, and an aryloxy group are preferred as a substituent, and it is desirable, also when these combine with each other and form the benzene ring.

[0057]In a formula (1e), a hydrogen atom is preferred as  $R_1$ ,  $R_{12}$  -  $R_{14}$ . As a substituent, aryl groups, such as alkoxy groups, such as alkyl groups, such as methyl, a cyano group, and methoxy, and phenyl, an aralkyl group, an alkenyl group, an acyloxy group, and an alkoxycarbonyl group are preferred, and it is desirable, also when neighboring groups join together and it forms the benzene ring.

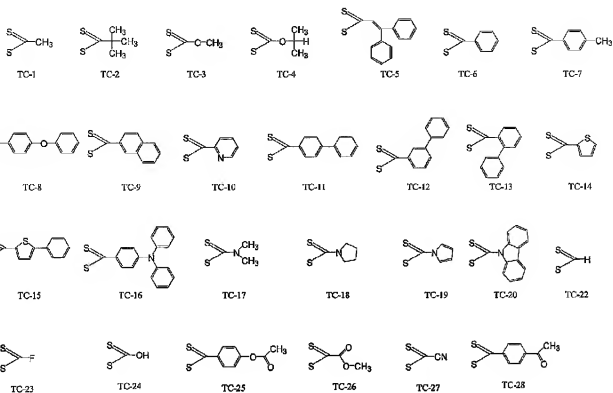
[0058]As  $R_2$  and  $R_{20}$ , a hydrogen atom is preferred, and aryl groups, such as halogen atoms, such as alkyl groups, such as methyl, and fluoride, and phenyl, an aryloxy group, and an acyl group are preferred as a substituent, and it is desirable, also when these combine with each other and form the benzene ring.

[0059]As a hetero atom expressed with X in a formula (1e), Although sulfur (S) and oxygen (O) are preferred and especially S is preferred, it may be  $NR_0$  ( $R_0$  is an alkyl group or an aryl group etc. which is not replaced [ a hydrogen atom, substitution, or ], and is a hydrogen atom, methyl, phenyl, etc. preferably.).

[0060]An example of a ligand of a dithiocarboxylic acid system in a formula (1a) and a platinum metal complex expressed with (1b) is shown below.

[0061]

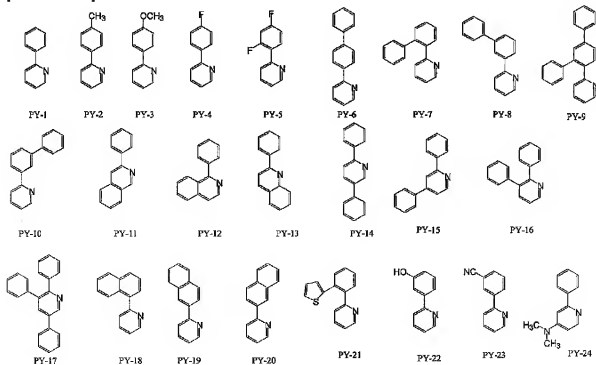
[Formula 16]



[0062] The example of an alt. metal-ized ligand is shown below.

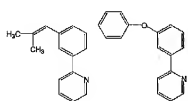
[0063]

[Formula 17]



[0064]

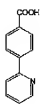
[Formula 18]



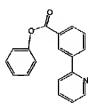
PY-25



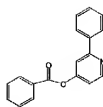
PY-26



PY-27



PY-28



PY-29



PY-30



PY-31

[0065]

[Formula 19]



Bq-1



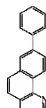
Bq-2



Bq-3



Bq-4



Bq-5



Bq-6



Bq-7



Bq-8



Bq-9



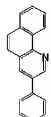
Bq-10



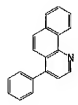
Bq-11



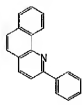
Bq-12



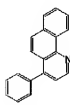
Bq-13



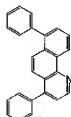
Bq-14



Bq-15



Bq-16



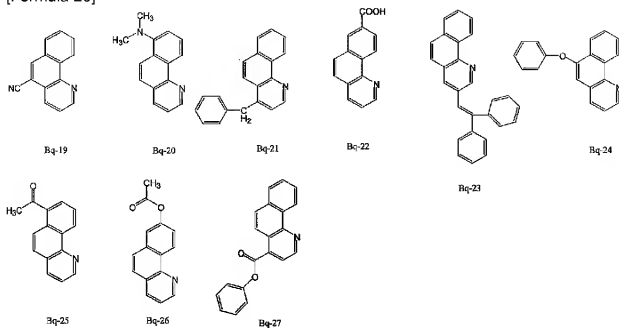
Bq-17



Bq-18

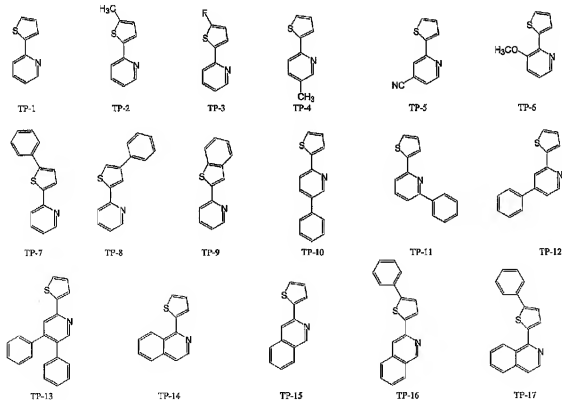
[0066]

[Formula 20]



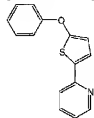
[0067]

[Formula 21]

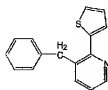


[0068]

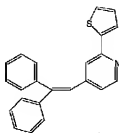
[Formula 22]



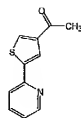
TP-18



TP-19



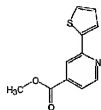
TP-20



TP-21



TP-22



TP-23

[0069]Next, a formula (1a) and the example of a platinum metal complex expressed with (1b) are shown below using the combination of these ligands.

[0070]

[Formula 23]

(配位子PY)<sub>n</sub>—M—(配位子TC)<sub>m</sub>

番号	中心金属M	配位子PY n	配位子TC m	番号	中心金属M	配位子PY n	配位子TC m	
A-1	Ir	PY-1	2 TO-17	1	A-64	Os	PY-1	2 TO-17
A-2	Ir	PY-1	2 TO-18	1	A-65	Os	PY-1	2 TO-18
A-3	Ir	PY-1	2 TO-4	1	A-66	Os	PY-1	2 TO-4
A-4	Ir	PY-2	2 TO-1	1	A-67	Os	PY-2	2 TO-1
A-5	Ir	PY-3	2 TO-2	1	A-68	Os	PY-3	2 TO-2
A-6	Ir	PY-4	2 TO-3	1	A-69	Os	PY-4	2 TO-3
A-7	Ir	PY-5	2 TO-4	1	A-70	Os	PY-5	2 TO-4
A-8	Ir	PY-6	2 TO-5	1	A-71	Os	PY-6	2 TO-5
A-9	Ir	PY-7	2 TO-6	1	A-72	Os	PY-7	2 TO-6
A-10	Ir	PY-8	2 TO-7	1	A-73	Os	PY-8	2 TO-7
A-11	Ir	PY-9	2 TO-8	1	A-74	Os	PY-9	2 TO-8
A-12	Ir	PY-10	2 TO-9	1	A-75	Os	PY-10	2 TO-9
A-13	Ir	PY-11	2 TO-10	1	A-76	Os	PY-11	2 TO-10
A-14	Ir	PY-12	2 TO-11	1	A-77	Os	PY-12	2 TO-11
A-15	Ir	PY-13	2 TO-12	1	A-78	Os	PY-13	2 TO-12
A-16	Ir	PY-14	2 TO-13	1	A-79	Os	PY-14	2 TO-13
A-17	Ir	PY-15	2 TO-14	1	A-80	Os	PY-15	2 TO-14
A-18	Ir	PY-16	2 TO-15	1	A-81	Os	PY-16	2 TO-15
A-19	Ir	PY-17	2 TO-16	1	A-82	Os	PY-17	2 TO-16
A-20	Ir	PY-18	2 TO-17	1	A-83	Os	PY-18	2 TO-17
A-21	Ir	PY-20	2 TO-20	1	A-84	Os	PY-20	2 TO-20
A-22	Pd	PY-1	1 TO-17	1	A-85	Pd	PY-1	1 TO-17
A-23	Pd	PY-1	1 TO-18	1	A-86	Pd	PY-1	1 TO-18
A-24	Pd	PY-1	1 TO-4	1	A-87	Pd	PY-1	1 TO-4
A-25	Pd	PY-2	1 TO-1	1	A-88	Pd	PY-2	1 TO-1
A-26	Pd	PY-3	1 TO-2	1	A-89	Pd	PY-3	1 TO-2
A-27	Pd	PY-4	1 TO-3	1	A-90	Pd	PY-4	1 TO-3
A-28	Pd	PY-5	1 TO-4	1	A-91	Pd	PY-5	1 TO-4
A-29	Pd	PY-6	1 TO-5	1	A-92	Pd	PY-6	1 TO-5
A-30	Pd	PY-7	1 TO-6	1	A-93	Pd	PY-7	1 TO-6
A-31	Pd	PY-8	1 TO-7	1	A-94	Pd	PY-8	1 TO-7
A-32	Pd	PY-9	1 TO-8	1	A-95	Pd	PY-9	1 TO-8
A-33	Pd	PY-10	1 TO-9	1	A-96	Pd	PY-10	1 TO-9
A-34	Pd	PY-11	1 TO-10	1	A-97	Pd	PY-11	1 TO-10
A-35	Pd	PY-12	1 TO-11	1	A-98	Pd	PY-12	1 TO-11
A-36	Pd	PY-13	1 TO-12	1	A-99	Pd	PY-13	1 TO-12
A-37	Pd	PY-14	1 TO-13	1	A-100	Pd	PY-14	1 TO-13
A-38	Pd	PY-15	1 TO-14	1	A-101	Pd	PY-15	1 TO-14
A-39	Pd	PY-16	1 TO-15	1	A-102	Pd	PY-16	1 TO-15
A-40	Pd	PY-17	1 TO-16	1	A-103	Pd	PY-17	1 TO-16
A-41	Pd	PY-18	1 TO-17	1	A-104	Pd	PY-18	1 TO-17
A-42	Pd	PY-20	1 TO-20	1	A-105	Pd	PY-20	1 TO-20
A-43	Rh	PY-1	2 TO-17	1	A-106	Ru	PY-1	2 TO-17
A-44	Rh	PY-1	2 TO-18	1	A-107	Ru	PY-1	2 TO-18
A-45	Rh	PY-1	2 TO-4	1	A-108	Ru	PY-1	2 TO-4
A-46	Rh	PY-2	2 TO-1	1	A-109	Ru	PY-2	2 TO-1
A-47	Rh	PY-3	2 TO-2	1	A-110	Ru	PY-3	2 TO-2
A-48	Rh	PY-4	2 TO-3	1	A-111	Ru	PY-4	2 TO-3
A-49	Rh	PY-5	2 TO-4	1	A-112	Ru	PY-5	2 TO-4
A-50	Rh	PY-6	2 TO-5	1	A-113	Ru	PY-6	2 TO-5
A-51	Rh	PY-7	2 TO-6	1	A-114	Ru	PY-7	2 TO-6
A-52	Rh	PY-8	2 TO-7	1	A-115	Ru	PY-8	2 TO-7
A-53	Rh	PY-9	2 TO-8	1	A-116	Ru	PY-9	2 TO-8
A-54	Rh	PY-10	2 TO-9	1	A-117	Ru	PY-10	2 TO-9
A-55	Rh	PY-11	2 TO-10	1	A-118	Ru	PY-11	2 TO-10
A-56	Rh	PY-12	2 TO-11	1	A-119	Ru	PY-12	2 TO-11
A-57	Rh	PY-13	2 TO-12	1	A-120	Ru	PY-13	2 TO-12
A-58	Rh	PY-14	2 TO-13	1	A-121	Ru	PY-14	2 TO-13
A-59	Rh	PY-15	2 TO-14	1	A-122	Ru	PY-15	2 TO-14
A-60	Rh	PY-16	2 TO-15	1	A-123	Ru	PY-16	2 TO-15
A-61	Rh	PY-17	2 TO-16	1	A-124	Ru	PY-17	2 TO-16
A-62	Rh	PY-18	2 TO-17	1	A-125	Ru	PY-18	2 TO-17
A-63	Rh	PY-20	2 TO-20	1	A-126	Ru	PY-20	2 TO-20

[0071]

[Formula 24]

(配位子Ba)n-m-(配位子TC)m									
番号	中心金属M	配位子Ba(n)	配位子TC(m)	番号	中心金属M	配位子Ba(n)	配位子TC(m)	番号	中心金属M
B-1	Ir	Ba-1	2	TC-1	1	B-64	Os	Ba-1	2
B-2	Ir	Ba-1	2	TC-18	1	B-65	Os	Ba-1	2
B-3	Ir	Ba-1	2	TC-4	1	B-66	Os	Ba-1	2
B-4	Ir	Ba-2	2	TC-1	1	B-67	Os	Ba-2	2
B-5	Ir	Ba-3	2	TC-2	1	B-68	Os	Ba-3	2
B-6	Ir	Ba-4	2	TC-3	1	B-69	Os	Ba-4	2
B-7	Ir	Ba-5	2	TC-4	1	B-70	Os	Ba-5	2
B-8	Ir	Ba-6	2	TC-5	1	B-71	Os	Ba-6	2
B-9	Ir	Ba-7	2	TC-6	1	B-72	Os	Ba-7	2
B-10	Ir	Ba-8	2	TC-7	1	B-73	Os	Ba-8	2
B-11	Ir	Ba-9	2	TC-8	1	B-74	Os	Ba-9	2
B-12	Ir	Ba-10	2	TC-9	1	B-75	Os	Ba-10	2
B-13	Ir	Ba-11	2	TC-10	1	B-76	Os	Ba-11	2
B-14	Ir	Ba-12	2	TC-11	1	B-77	Os	Ba-12	2
B-15	Ir	Ba-13	2	TC-12	1	B-78	Os	Ba-13	2
B-16	Ir	Ba-14	2	TC-13	1	B-79	Os	Ba-14	2
B-17	Ir	Ba-15	2	TC-14	1	B-80	Os	Ba-15	2
B-18	Ir	Ba-16	2	TC-15	1	B-81	Os	Ba-16	2
B-19	Ir	Ba-17	2	TC-16	1	B-82	Os	Ba-17	2
B-20	Ir	Ba-18	2	TC-17	1	B-83	Os	Ba-18	2
B-21	Ir	Ba-19	2	TC-18	1	B-84	Os	Ba-19	2
B-22	Ir	Ba-20	2	TC-19	1	B-85	Os	Ba-20	2
B-23	Ir	Ba-21	2	TC-20	1	B-86	Os	Ba-21	2
B-24	Ir	Ba-22	2	TC-21	1	B-87	Os	Ba-22	2
B-25	Ir	Ba-23	2	TC-22	1	B-88	Os	Ba-23	2
B-26	Ir	Ba-24	2	TC-23	1	B-89	Os	Ba-24	2
B-27	Ir	Ba-25	2	TC-24	1	B-90	Os	Ba-25	2
B-28	Ir	Ba-26	2	TC-25	1	B-91	Os	Ba-26	2
B-29	Ir	Ba-27	2	TC-26	1	B-92	Os	Ba-27	2
B-30	Ir	Ba-28	2	TC-27	1	B-93	Os	Ba-28	2
B-31	Ir	Ba-29	2	TC-28	1	B-94	Os	Ba-29	2
B-32	Ir	Ba-30	2	TC-29	1	B-95	Os	Ba-30	2
B-33	Ir	Ba-31	2	TC-30	1	B-96	Os	Ba-31	2
B-34	Ir	Ba-32	2	TC-31	1	B-97	Os	Ba-32	2
B-35	Ir	Ba-33	2	TC-32	1	B-98	Os	Ba-33	2
B-36	Ir	Ba-34	2	TC-33	1	B-99	Os	Ba-34	2
B-37	Ir	Ba-35	2	TC-34	1	B-100	Os	Ba-35	2
B-38	Ir	Ba-36	2	TC-35	1	B-101	Os	Ba-36	2
B-39	Ir	Ba-37	2	TC-36	1	B-102	Os	Ba-37	2
B-40	Ir	Ba-38	2	TC-37	1	B-103	Os	Ba-38	2
B-41	Ir	Ba-39	2	TC-38	1	B-104	Os	Ba-39	2
B-42	Ir	Ba-40	2	TC-39	1	B-105	Os	Ba-40	2
B-43	Ir	Ba-41	2	TC-40	1	B-106	Os	Ba-41	2
B-44	Ir	Ba-42	2	TC-41	1	B-107	Os	Ba-42	2
B-45	Ir	Ba-43	2	TC-42	1	B-108	Os	Ba-43	2
B-46	Ir	Ba-44	2	TC-43	1	B-109	Os	Ba-44	2
B-47	Ir	Ba-45	2	TC-44	1	B-110	Os	Ba-45	2
B-48	Ir	Ba-46	2	TC-45	1	B-111	Os	Ba-46	2
B-49	Ir	Ba-47	2	TC-46	1	B-112	Os	Ba-47	2
B-50	Ir	Ba-48	2	TC-47	1	B-113	Os	Ba-48	2
B-51	Ir	Ba-49	2	TC-48	1	B-114	Os	Ba-49	2
B-52	Ir	Ba-50	2	TC-49	1	B-115	Os	Ba-50	2
B-53	Ir	Ba-51	2	TC-50	1	B-116	Os	Ba-51	2
B-54	Ir	Ba-52	2	TC-51	1	B-117	Os	Ba-52	2
B-55	Ir	Ba-53	2	TC-52	1	B-118	Os	Ba-53	2
B-56	Ir	Ba-54	2	TC-53	1	B-119	Os	Ba-54	2
B-57	Ir	Ba-55	2	TC-54	1	B-120	Os	Ba-55	2
B-58	Ir	Ba-56	2	TC-55	1	B-121	Os	Ba-56	2
B-59	Ir	Ba-57	2	TC-56	1	B-122	Os	Ba-57	2
B-60	Ir	Ba-58	2	TC-57	1	B-123	Os	Ba-58	2
B-61	Ir	Ba-59	2	TC-58	1	B-124	Os	Ba-59	2
B-62	Ir	Ba-60	2	TC-59	1	B-125	Os	Ba-60	2
B-63	Ir	Ba-61	2	TC-60	1	B-126	Os	Ba-61	2

[0072]

[Formula 25]

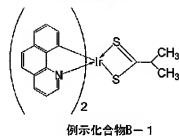
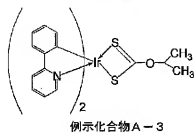
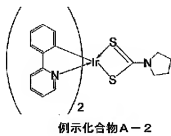
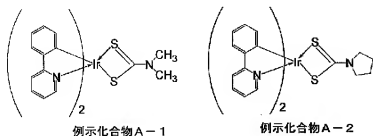
		(配位子TP)n—M—(配位子TC)m			
番号	中心金属	配位子TP	n	配位子TC	m
G-1	Ir	TP-1	1	TC-17	1
G-2	Ir	TP-1	2	TC-18	1
G-3	Ir	TP-1	2	TC-4	1
G-4	Ir	TP-2	1	TC-6	1
G-5	Ir	TP-2	2	TC-2	1
G-6	Ir	TP-4	2	TC-3	1
G-7	Ir	TP-5	1	TC-4	1
G-8	Ir	TP-6	2	TC-6	1
G-9	Ir	TP-7	2	TC-6	1
G-10	Ir	TP-6	2	TC-7	1
G-11	Ir	TP-8	2	TC-8	1
G-12	Ir	TP-10	2	TC-9	1
G-13	Ir	TP-11	2	TC-10	1
G-14	Ir	TP-12	2	TC-11	1
G-15	Ir	TP-13	2	TC-12	1
G-16	Ir	TP-14	2	TC-13	1
G-17	Ir	TP-15	2	TC-14	1
G-18	Ir	TP-15	2	TC-15	1
G-19	Ir	TP-17	2	TC-16	1
G-20	Ir	TP-18	2	TC-18	1
G-21	Ir	TP-20	2	TC-20	1
G-22	Pd	TP-1	1	TC-17	1
G-23	Pd	TP-1	1	TC-18	1
G-24	Pd	TP-1	1	TC-4	1
G-25	Pd	TP-2	1	TC-1	1
G-26	Pd	TP-2	1	TC-2	1
G-27	Pd	TP-3	1	TC-3	1
G-28	Pd	TP-5	1	TC-4	1
G-29	Pd	TP-6	1	TC-6	1
G-30	Pd	TP-7	1	TC-6	1
G-31	Pd	TP-6	1	TC-7	1
G-32	Pd	TP-6	1	TC-8	1
G-33	Pd	TP-9	1	TC-9	1
G-34	Pd	TP-11	1	TC-10	1
G-35	Pd	TP-12	1	TC-11	1
G-36	Pd	TP-13	1	TC-12	1
G-37	Pd	TP-14	1	TC-13	1
G-38	Pd	TP-15	1	TC-14	1
G-39	Pd	TP-18	1	TC-16	1
G-40	Pd	TP-17	1	TC-18	1
G-41	Pd	TP-18	1	TC-18	1
G-42	Pd	TP-20	1	TC-20	1
G-43	Rh	TP-1	2	TC-17	1
G-44	Rh	TP-1	2	TC-18	1
G-45	Rh	TP-1	2	TC-4	1
G-46	Rh	TP-2	2	TC-1	1
G-47	Rh	TP-6	2	TC-2	1
G-48	Rh	TP-4	2	TC-3	1
G-49	Rh	TP-6	2	TC-4	1
G-50	Rh	TP-6	2	TC-6	1
G-51	Rh	TP-7	2	TC-6	1
G-52	Rh	TP-6	2	TC-7	1
G-53	Rh	TP-8	2	TC-8	1
G-54	Rh	TP-10	2	TC-9	1
G-55	Rh	TP-11	2	TC-10	1
G-56	Rh	TP-12	2	TC-11	1
G-57	Rh	TP-13	2	TC-12	1
G-58	Rh	TP-14	2	TC-13	1
G-59	Rh	TP-15	2	TC-14	1
G-60	Rh	TP-18	2	TC-16	1
G-61	Rh	TP-17	2	TC-18	1
G-62	Rh	TP-18	2	TC-18	1
G-63	Rh	TP-20	2	TC-20	1

[0073] Such a platinum metal complex can be obtained by the ability to make a chlorine bridge construction 2 core complex with a corresponding alt. metal-ized ligand, and the dithiocarboxylic acid system salt corresponding to a desired dithiocarboxylic acid system ligand able to react in the specified quantity and a nonaqueous solvent. A  $^1\text{H}$  nuclear magnetic resonance spectrum ( $^1\text{H NMR}$ ), a mass (MS) spectrum, ultimate analysis, etc. can perform identification.

[0074] Below, the synthetic example about the following compound is shown.

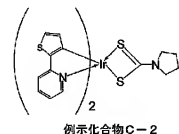
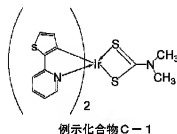
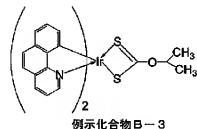
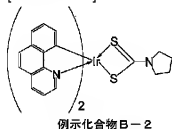
[0075]

[Formula 26]



[0076]

[Formula 27]



[0077] composition of a synthetic example 1 illustration compound (A-1) -- a law -- [bis(2-phenylpyridino)iridium chloride]  $\cdot 270\text{mg}$  (0.25 mmol) compounded by the method -- dichloromethane (50 ml). Methanol (20 ml) After melting in a mixed solvent, sodium-dimethyldithiocarbamate 72 mg (0.5 mmol) was added, and it stirred under the room temperature for 3 hours. Column chromatography and recrystallization refined after solvent removal, and the object of yellow powder was obtained by yield 78 % (244 mg, 0.39 mmol).  $^1\text{H}$  NMR, MS spectrum, and ultimate analysis performed identification.

[0078]  $^1\text{H}$  NMR: ( $\text{CDCl}_3$ ) .  $\delta$  3.22 (s, 6H), 6.33 (d, 2H), 6.67 (t, 2H), 6.78 (t, 2H), 7.219 (t, 2H), 7.57 (d, 2H), 7.75 (t, 2H), 7.87 (d, 2H), (d, 2H) 9.61 MS (EI+, 1.3 kv)  $m/z = 621$  ( $\text{M}^+$ ,

Ir=193, 68), ( $M^+$ , Ir=191, 39) 619 501 ( $Irppy_2^+$ , Ir=193, 100), 499 ( $Irppy_2^+$ , Ir=191, 54). ultimate analysis; calculated value (%) [ $C_{25}H_{22}N_3S_2$  Ir (620.81)]: C 48.37, H 3.57, N 6.77; Actual measurement (%): C 48.25, H 3.63, N 6.39 [0079] Instead of synthetic sodium dimethyldithiocarbamate of a synthetic example 2 illustration compound (A-2), except having used pyrrolidine 1 \*\*JICHIO ammonium acetate, it compounded by the same method as the synthetic example 1, and the object of yellow powder was obtained (yield: 66 %).  $^1H$  NMR and MS spectrum performed identification.

[0080]  $^1H$  NMR: ( $CDCl_3$ ) .  $\delta$  2.00 (p, 4H), 3.71 (m, 4H), 6.35 (d, 2H), 6.69 (t, 2H), 6.80 (t, 2H), 7.23 (t, 2H), 7.58 (d, 2H), 7.76 (t, 2H), (d, 2H) 7.88 9.68 MS (d, 2H) (EI+, 1.3 kv)  $m/z$  = 647 ( $M^+$ , Ir=193, 90), 645 ( $M^+$ , Ir=191, 60) 501 ( $Irppy_2^+$ , Ir=193, 100), 499 ( $Irppy_2^+$ , Ir=191, 55), and 154 ( $ppy^+$ , 71) [0081] Instead of synthetic sodium dimethyldithiocarbamate of a synthetic example 3 illustration compound (A-3), except having used sodium dithioacetate O \*\*ISOPUROPIO ester, it compounded by the same method as the synthetic example 1, and an object of yellow powder was obtained (yield: 87 %).  $^1H$  NMR and MS spectrum performed identification.

[0082]  $^1H$  NMR: ( $CDCl_3$ ) .  $\delta$  1.39 (d, 3H), 1.48 (d, 3H), 5.52 (p, 1H), 6.35 (d, 2H), 6.74 (t, 2H), 6.86 (t, 2H), 7.23 (t, 2H), 7.60 (d, 2H), (t, 2H) 7.79 7.90 (d, 2H) and 9.37 MS (d, 2H) (EI+, 1.3 kv)  $m/z$  = 636 ( $M^+$ , Ir=193, 35), 634 ( $M^+$ , Ir=191, 20) 501 ( $Irppy_2^+$ , Ir=193, 100) and 499 ( $Irppy_2^+$ , Ir=191, 64) [0083] composition of a synthetic example 4 illustration compound (B-1) -- a law -- [bis(benzo [h] KINORINO)iridium chloride]  $_2$  270 mg (0.25 mmol) compounded by a method -- dichloromethane (50 ml). Sodium dimethyldithiocarbamate after melting in a mixed solvent of methanol (20 ml) 72 mg (0.5 mmol) was added and it stirred under a room temperature for 3 hours. Column chromatography and recrystallization refined after solvent removal, and an object of yellow powder was obtained (yield: 41%).  $^1H$  NMR performed identification.

[0084]  $^1H$  NMR (it  $CDCl_3$  and) 500 . MHz:  $\delta$  5.30 (s, 6H), 6.37 (dd, 2H), 6.94 (t, 2H), 7.27 (d, 2H), 7.64 (m, 4H), 7.74 (d, 2H), 8.24 (dd, 2H), 9.87 (dd, 2H) [0085] Instead of synthetic sodium dimethyldithiocarbamate of a synthetic example 5 illustration compound (B-2), except having used pyrrolidine 1 \*\*JICHIO ammonium acetate, composition and refining were performed by the same method as the synthetic example 4, and an object of yellow powder was obtained (yield: 60%).  $^1H$  NMR and ultimate analysis performed identification.

[0086]  $^1\text{H}$  NMR: ( $\text{CDCl}_3$ ).  $\delta$  2.00 (t, 4H), 3.70 (m, 4H), 6.36 (d, 2H), 6.94 (t, 2H), 7.24 (d, 2H), 7.63 (m, 4H), 7.73 (d, 2H), 8.23 (dd, 2H), (dd, 2H) 9.93 Ultimate analysis; calculated value (%) [ $\text{C}_{31}\text{H}_{24}\text{N}_3\text{S}_2$  Ir (694.89)]: C 53.58, H 3.48, N 6.05; actual measurement (%): C 52.89, H 3.16, N 5.89 [0087] Instead of synthetic sodium dimethyldithiocarbamate of a synthetic example 6 illustration compound (B-3), except having used sodium dithioacetate O \*\*ISOPUROPIO ester, composition and refining were performed by the same method as the synthetic example 4, and an object of yellow powder was obtained (yield: 60%).  $^1\text{H}$  NMR performed identification.

[0088]  $^1\text{H}$  NMR: ( $\text{CDCl}_3$ ).  $\delta$  1.41 (d, 3H), 1.51 (d, 3H), 5.55 (p, 1H), 6.37 (d, 2H), 7.00 (t, 2H), 7.31 (d, 2H), 7.66 (m, 4H), 7.78 (d, 2H), 8.28 (d, 2H), 9.65 (d, 2H) [0089] composition of a synthetic example 7 illustration compound (C-1) -- a law -- [bis(2-(2 \*\*CHIENTIRU) pyridyl) iridium chloride]  $\cdot 270$  mg (0.25 mmol) compounded by a method -- dichloromethane (50 ml).

Sodium dimethyldithiocarbamate after melting in a mixed solvent of methanol (20 ml) 72 mg (0.5 mmol) was added and it stirred under a room temperature for 3 hours. Column chromatography and recrystallization refined after solvent removal, and an object of orange powder was obtained (yield: 41%).  $^1\text{H}$  NMR performed identification.

[0090]  $^1\text{H}$  NMR ( $\text{CDCl}_3$ )  $\delta$  = 3.21 (s, 6H), 6.22 (d, 2H), 6.99 (t, 2H), 7.14 (d, 2H), 7.49 (d, 2H), 7.61 (t, 2H), and 9.39 (d, 2H) [0091] Instead of synthetic sodium dimethyldithiocarbamate of a synthetic example 8 illustration compound (C-2), except having used pyrrolidine 1 \*\*JICHIO ammonium acetate, composition and refining were performed by the same method as the synthetic example 7, and an object of orange powder was obtained (yield: 66 %).  $^1\text{H}$  NMR and ultimate analysis performed identification. This result is shown below.

[0092]  $^1\text{H}$  NMR: ( $\text{CDCl}_3$ ).  $\delta$  1.98 (quin, 4H), 3.68 (t, 4H), 6.21 (d, 2H), 6.99 (t, 2H), 7.13 (d, 2H), 7.48 (d, 2H), 7.60 (t, 2H), 9.44 Ultimate analysis (d, 2H). Calculated value (%) [ $\text{C}_{23}\text{H}_{20}\text{N}_3\text{S}_4$  Ir (658.91)]: C 41.92, H 3.06, N 6.38; Actual measurement (%): C 41.44, H 2.77, N 6.17 [0093] As a luminescent material, one sort of such platinum metal complexes may be used for a luminous layer, or may use two or more sorts together.

[0094] In this case, as for a platinum metal complex, using as a dopant in a luminous layer is preferred, A host material used combining this is an organic compound, and the minimum excitation triplet energy of this organic compound has a preferred thing with a larger value than the minimum excitation triplet energy of a platinum metal complex. Such minimum excitation triplet energy is the value calculated from a phosphorescence spectrum of an organic compound, and, as for these differences, 0.1-2.0 eV and further 0.1-1.0 eV are usually

preferred.

[0095]If conditions which have the bigger minimum excitation triplet energy than the minimum excitation triplet energy of a platinum metal complex are fulfilled about a host material, there will be no restriction in particular, but specifically, An oxadiazole derivative, an imidazole derivative, a thiazole derivative, A triazole derivative, an oligo phenylene derivative, a NAFUTARU imide derivative, an aromatic amine derivative, a carbazole derivative, a phenoxazine derivative, a phenothiazine derivative, a quinoline derivative, a phenanthroline derivative, a cyclopentadiene derivative, etc. are mentioned.

[0096]As for the mixing ratio of a host material and a dopant material, when these sum totals are made into 100% (mass percentage), it is preferred that a dopant material is 0.1 to 30% (mass percentage).

[0097]And it is preferred to make a luminous layer contain a further different organic compound from this besides the above-mentioned host material still more preferably. This organic compound also has a value with the larger minimum excitation triplet energy than a platinum metal complex which is a dopant, and, as for these differences, 0.1-2.0 eV and further 0.1-1 eV should be just preferred.

[0098]Such an organic compound promotes a hole to a luminous layer, and/or pouring of an electron, When it is an auxiliary material which has the function to raise a hole in a luminous layer, and electronic balance, and to increase luminescence intensity and a host material has electron transport property, As for an auxiliary material, it is preferred to use a compound of hole transportability, and as for an auxiliary material, when a host material has hole transportability, it is preferred to use a compound of electron transport property. Specifically, what satisfies conditions can be chosen from the aforementioned host materials.

[0099]Although the mixing ratio in particular of a host material in a luminous layer, a dopant material, and an auxiliary material was not restricted, when these sum totals are made into 100% (mass percentage), It is preferred that a host material is included 50 to 99% (mass percentage), and an auxiliary material is included 1 to 50% (mass percentage) 0.1 to 30% (mass percentage) as for a dopant material.

[0100]Although it is also preferred to make a luminous layer into the above mixed layers, in this invention, it can also be considered as a laminated structure of a luminous layer (phosphorescence luminous layer) containing a platinum metal complex, and a luminous layer (firefly luminescence layer) which adjoins this luminous layer and contains a fluorescent luminescence organic compound.

[0101]Since it becomes possible as fluorescence from a firefly luminescence layer to take out from a phosphorescence luminous layer outside as a phosphorescence, respectively about an excitation singlet state generated in a luminous layer by considering it as such a laminated structure, and an excitation triplet state, luminescence intensity can be raised. Adjustment of a

luminous wavelength is attained by changing thickness of each class, concentration of a dopant, etc.

[0102]As for a luminous layer containing a platinum metal complex, it is preferred that it is a layer which uses a platinum metal complex as a dopant and contains a host material. As a host material, the same organic compound as the above can also be used.

[0103]As for content of a platinum metal complex in a luminous layer containing such a platinum metal complex, it is preferred that it is 0.1 to 30% (mass percentage). Luminous layers containing such a platinum metal complex may be the above mixed layers and a layer of the composition.

[0104]A luminous layer containing the above-mentioned platinum metal complex and a luminous layer laminated are layers containing a fluorescent luminescence organic compound. As a layer which does not contain a platinum metal complex and specifically contains at least one kind of fluorescent luminescence organic compound, it is preferred to contain a host material and a dopant material.

[0105]An oxadiazole derivative used suitably for a layer containing a platinum metal complex as a host material, An imidazole derivative, a thiazole derivative, a triazole derivative, an oligo phenylene derivative, A NAFUTARU imide derivative, an aromatic amine derivative, a carbazole derivative, A phenoxazine derivative, a phenothiazine derivative, a quinoline derivative, a phenanthroline derivative, It may be a cyclopentadiene derivative and metal complexes, such as an anthracene derivative, a naphthacene derivative, a quinoxaline derivative, and tris(8-KINORINO rate) aluminum, can be conveniently used besides these. Two or more sorts in said host material may be mixed by arbitrary ratios. Although not limited, especially as a dopant which carries out firefly luminescence An anthracene derivative, A naphthacene derivative, a pentacene derivative, a pyrene derivative, a perylene derivative, A fluoranthene derivative, a quinacridone derivative, a coumarin derivative, a screw styryl arylene derivative, a screw styryl arylamine derivative, a thiophene derivative, a pyridine derivative, etc. can be used conveniently.

[0106]As for content of a dopant material in a luminous layer containing such a fluorescent luminescence organic compound, it is preferred that it is 0.1 to 30% (mass percentage).

[0107]An organic compound in this invention may contain metal like an organometallic complex besides the usual carbon system compound.

[0108]Forming by the applying method can also form a luminous layer containing a platinum metal complex of this invention with vacuum deposition, such as a vacuum deposition method. In a luminous layer above-mentioned mixed layer type, when based on the applying method, 0.5-1000 nm per layer is preferred, and is 10-500 nm more preferably. When based on vacuum deposition, it is 1-500 nm. On the other hand, when considering it as a lamination type luminous layer, it is preferred that total thickness shall be 10-200 nm, and it should just choose

from a mentioned range thickness per layer of a luminous layer which contains a platinum metal complex with a formation method, and a luminous layer laminated by this.

[0109]An example of composition of an organic EL device with such a luminous layer is shown in drawing 1 and drawing 2.

[0110]Drawing 1 is an example of element composition with a luminous layer above-mentioned mixed layer type. An organic EL device of drawing 1 has the anode 2 on the substrate 1, and on this, the phosphorescence luminous layer 6, the electron transport layer 7, and the electronic injection layer 8 which contain the hole pouring layer 3, the hole transporting bed 4, and a platinum metal complex one by one are \*\*\*\*(ed), and it has the negative pole 9 on this further.

[0111]Drawing 2 is an example of element composition with a luminous layer above-mentioned lamination type, and forms the firefly luminescence layer 5 between the hole transporting bed 4 and the phosphorescence luminous layer 6 further in drawing 1.

[0112]Although the hole pouring layer 3 and the hole transporting bed 4 are considered as composition provided as a different layer in an example of a graphic display, it may provide as a hole pouring transporting bed which gave a function of hole pouring transportability to the same layer. Also in the electron transport layer 7 and the electronic injection layer 8, it is the same, and may provide as an electron injection transporting bed.

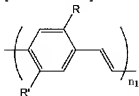
[0113]Although the part was described above in this invention as organic materials for forming organic layers other than the aforementioned platinum metal complex, Luminescent materials, charge transporting materials (it is a general term of electron-transport-property material and hole transportability material.), etc. also including these which are generally used for an organic EL device can be used. It may replace with these electron injections and/or a transporting bed, hole pouring, and/or a transporting bed, and may have electron injection and/or a transporting bed of high resistance by an inorganic material, and hole pouring and/or a transporting bed.

[0114]In this invention, when an organic layer in an element of a coating mold secures a function as an element of a coating mold, it is preferred to contain a high molecular compound. In the case of a polymer, a molecular weight of such a high molecular compound is expressed with the weight average molecular weight Mw, and is usually 5000 to about 3 million 5000 or more.

[0115]Although used as a luminescent material and a hole transportability material, mainly specifically, Polyethylene dioxythiophene / polystyrene SARUFONETO (PEDOT/PSS), A polyvinyl carbazole (PVK), a metal-phthalocyanines compound, poly aniline / polystyrene SARUFONETO (Pani/PSS), Either a poly para-phenylene vinylene derivative (PPV derivative) of a following formula (P-1) and a poly aryl fluorene derivative of a following formula (P-2) and these mixtures can be mentioned.

[0116]

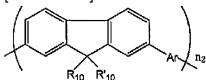
[Formula 28]



[0117](R is 2-ethylhexyloxy group, R' is a methoxy group,  $n_1$  expresses a degree of polymerization and Mw is 50000.)

[0118]

[Formula 29]



[0119]( $R_{10}$  and  $R'_{10}$  is an alkyl group respectively, Ar is the aromatic ring group or heterocycle group which may have a substituent,  $n_2$  expresses a degree of polymerization and Mw(s) are 5000-3 million.)

As a charge transport nature material which can be used for this invention, various electron-transport-property materials and hole transportability material can be used, and it is not limited in particular.

[0120]As a hole transportability material, a pyrazoline derivative, an arylamine derivative, a stilbene derivative, a triphenyl diamine derivative, etc. can be mentioned.

[0121]As an electron-transport-property material, an oxadiazole derivative, anthraquinodimethane, and its derivative, Benzoquinone and its derivative, a naphthoquinone and its derivative, anthraquinone, and its derivative, Tetracyano ANSURA quinodimethane and its derivative, a fluorene, and its derivative, Metal complexes, such as diphenyldicyanoethylene and its derivative, a diphenoquinone derivative, 8-hydroxyquinoline and its derivative, a phenanthroline, and its derivative, etc. can be mentioned.

[0122]Specifically, what is indicated in JP,63-70257,A, a 63-175860 gazette, JP,2-135359,A, a 2-135361 gazette, a 2-209988 gazette, a 3-37992 gazette, and a 3-152184 gazette can be mentioned.

[0123]Especially as a hole transportability material, 4,4-bis(N-(3-methylphenyl)-N-phenylamino)biphenyl, As an electron-transport-property material, 2-(4-biphenyl)-5-(4-*t*-butylphenyl)-1,3,4-oxadiazole, benzoquinone, anthraquinone, tris(8-quinolinolato) aluminum, a phenanthroline, and its derivative are preferred.

[0124]When it thin-film-izes by the applying method, in order to remove a solvent, it is desirable under decompression or an inert atmosphere to carry out stoving at temperature of 60-100 °C preferably 30-200 °C.

[0125]When forming an electric charge pouring transporting bed in a lower layer of a luminous layer and formation of a luminous layer takes a heating polymerization process, a certain amount of heat resistance is needed. A not less than 200 °C compound has a glass transition temperature especially more preferably preferred [ in this case, ] not less than 150 °C not less than 100 °C preferably. Although there is no restriction in particular in a maximum of glass transition temperature, it is about 300 °C.

[0126]Although thickness of an organic hole pouring transporting bed and thickness in particular of an electron injection transporting bed are not restricted and change also with formation methods, it is usually preferred to be especially referred to as 10-300 nm about 5-500 nm. As for a pouring layer, when providing a pouring layer and a transporting bed of a hole, it is preferred that 1 nm or more and a transporting bed set to 1 nm or more. A maximum of thickness of a pouring layer at this time and a transporting bed is [ in a pouring layer ] usually about 500 nm at about 500 nm and a transporting bed.

[0127]As a solvent used for organic layer formation by spreading of this invention, organic materials dissolve, and especially if an obstacle does not arise when applying, it will not be limited. Specifically, things generally used, such as an alcohol system, a hydrocarbon system, a ketone system, and an ether system, can be used. Especially, chloroform, a methylene chloride, a dichloroethane, a tetrahydrofuran, toluene, xylene, etc. are preferred. Although a polymer material is based also on the structure and molecular weight, it can usually be dissolved in these solvents more than 0.1% (mass percentage).

[0128]Since the negative pole (electron injection electrode) does not need to have electron injection nature with a low work function when using combining electronic injection layers, such as LiF and CsI, as an inorganic electronic injection layer, as the material, it does not need to be limited in particular and usual metal can be used for it. Especially, one sort or two sorts or more of metallic elements chosen from aluminum, Ag, In, Ti, Cu, Au, Mo, W, Pt, Pd and nickel especially aluminum, and Ag are preferred in respect of conductivity or the ease of treatment. The thickness of these negative poles should just make an electron thickness more than [ which can be given to an inorganic electron injection transporting bed of high resistance ] fixed, and should just set it to not less than 100 nm preferably not less than 50 nm. What is necessary is for thickness just to be usually about 50-500 nm, although there is no restriction in particular in the upper limit.

[0129]The following may be used if needed as the negative pole (electron injection electrode). For example, K, Cs, Li, Na, Mg, La, Ce, Ca, Sr, Ba, Two ingredients which contain them in order to raise metallic element simple substances, such as Sn, Zn, and Zr, or stability, An alloy

system of three ingredients, for example, Ag and a Mg alloy, (0.1 to 50% (atomic ratio) of the amount of Ag), an aluminum-Li alloy (0.01 to 14% (atomic ratio) of the amount of Li(s)), In and a Mg alloy (Mg: 50 to 80% (atomic ratio)), aluminum, a Ca alloy (0.01 to 20% (atomic ratio) of the amount of Ca), etc. are mentioned. The thickness of the negative pole (electron injection electrode) should just make electron injection thickness more than [ which can be performed enough ] fixed, and should just set it to 1 nm or more 0.5 nm or more especially preferably 0.1 nm or more. What is necessary is for thickness just to be usually about 1-500 nm, although there is no restriction in particular in the upper limit. On the negative pole (electron injection electrode), an auxiliary electrode (protection electrode) may be provided further.

[0130]In order that thickness of an auxiliary electrode may secure electron injection efficiency and may prevent penetration of moisture, oxygen, or an organic solvent, what is necessary is just to make it into thickness more than fixed, and its range of 100-500 nm is especially preferably preferred not less than 100 more nm not less than 50 nm. When an auxiliary electrode layer is too thin, the effect is not acquired, and the step coverage nature of an auxiliary electrode layer becomes low, and connection with a terminal electrode becomes less enough. On the other hand, since stress of an auxiliary electrode layer will become large if an auxiliary electrode layer is too thick, evil in which a growth rate of a dark spot will become quick etc. arises. What is necessary is for an auxiliary electrode to choose optimal material with material of an electron injection electrode to combine, and just to use it. For example, if it thinks securing electron injection efficiency as important, when what is necessary will be just to use metal of low resistance, such as aluminum, and it will think closure nature as important, metallic compounds, such as TiN, may be used.

[0131]What is necessary is just to be usually about 50-500 nm as thickness of the whole which combined the negative pole (electron injection electrode) and an auxiliary electrode, although there is no restriction in particular. Combination of the negative pole (electron injection electrode) and an auxiliary electrode may be used for an electronic injection layer, and combination and homonymy of the negative pole.

[0132]As for material of the anode (hole injection electrode), what can pour in a hole efficiently to an inorganic hole pouring transporting bed or an organic hole pouring transporting bed is preferred, and its substance which is 4.5 eV - 5.5 eV of work functions is preferred. Specifically, what made main composition either tin dope indium oxide (ITO), zinc dope indium oxide (IZO), indium oxide ( $\text{In}_2\text{O}_3$ ), tin oxide ( $\text{SnO}_2$ ) and a zinc oxide (ZnO) is preferred. These oxides may be somewhat deflected from the stoichiometric composition. 1 to 20% (mass percentage) and further 5 to 12% (mass percentage) of the mixture ratio of  $\text{SnO}_2$  to  $\text{In}_2\text{O}_3$  is desirable. The mixture ratio of ZnO to  $\text{In}_2\text{O}_3$  in IZO is usually a 12 to 32% (mass percentage) grade.

[0133]The anode (hole injection electrode) may contain silicon oxide ( $\text{SiO}_2$ ) in order to adjust a work function.  $\text{SiO}_2$  [ as opposed to ITO in content of silicon oxide ( $\text{SiO}_2$ ) ] About 0.5 to 10% is preferred at a mole ratio. A work function of ITO increases by containing  $\text{SiO}_2$ .

[0134]As for especially an electrode of a side which takes out light, it is preferred that a luminous wavelength zone and light transmittance [ especially usually as opposed to each luminescent light 400-700 nm ] are not less than 90% not less than 80 more% not less than 50%. If transmissivity becomes low too much, the luminescence from a luminous layer itself will decline and it will become difficult to get about luminosity required as a light emitting device. Especially thickness of an electrode in that case has the preferred range of 50-300 nm 50-500 nm. Although the maximum does not have restriction in particular, if not much thick, worries about decline in transmissivity, exfoliation, etc. will arise. When thickness is too thin, sufficient effect is not acquired but there is a problem also in respect of film strength at the time of manufacture, etc. Such an electrode is the anode in many cases.

[0135]In order to prevent degradation of an organic layer of an element and an electrode, it is preferred to close an element top with a sealing plate etc. In order to prevent permeation of humidity, an adhesive resin layer is used for a sealing plate, and it pastes up and seals a sealing plate. Inactive gas of sealing gas, such as Ar, helium, and  $\text{N}_2$ , etc. are preferred. As for a moisture content of this sealing gas, it is especially more preferably preferred that it is 1 ppm or less 10 ppm or less 100 ppm or less. Although there is no lower limit in particular in this moisture content, it is usually about 0.1 ppm.

[0136]In this invention, as a substrate which forms an organic electroluminescence structure, Amorphous boards (for example, glass, quartz, etc.) and crystal substrates (for example, Si, GaAs, ZnSe, ZnS, GaP, InP, etc.) are mentioned, and a crystalline substance and a substrate which was amorphous or formed a metaled buffer layer can also be used for these crystal substrates. As a metal substrate, Mo, aluminum, Pt, Ir, Au, Pd, etc. can be used, and a glass substrate is used preferably. As for a substrate, when becoming the optical extraction side, it is preferred to have the same light transmittance state as the above-mentioned electrode.

[0137]Many elements of this invention may be arranged in on a flat surface. The luminescent color of each element arranged in on a flat surface can be changed, and it can be made a display in color.

[0138]The luminescent color may be controlled using color conversion membrane which contains a color filter film and a fluorescence substance in a substrate, or a dielectric reflecting film.

[0139]Although an organic EL device of this invention is used as a direct-current drive type and a pulse drive type EL element, it can also usually be made into an alternating current drive. Impressed electromotive force is usually made into about 2-30V.

[0140]Like an example of a graphic display, an organic EL device of this invention has good substrate / anode / organic layer (a luminous layer is included.) / negative pole also as composition laminated one by one, and it is good also as this reverse laminated constitution, for example. What is necessary is just to determine laminated constitution as optimal thing suitably by specification, a production process, etc. of a display, for example.

[0141]An organic EL device of this invention can be used for various optical application devices, such as repeating installation in a transmission line of an optical pickup and optical communications which are used for everything but application as a display, for example, memory read-out / writing etc., and a photocoupler.

[0142]

[Example]Hereafter, an example explains this invention concretely. A comparative example is written together.

[0143]After UV/O<sub>3</sub>-washing the glass substrate in which the <Example 1> ITO transparent electrode was patterned, After carrying out spin coating (50 nm) of the poly (3, 4 \*\*ECHI range oxythiophene / polystyrene sulfonate) (PEDOT/PSS) solution (1.6% (mass percentage)) under the room temperature atmosphere as a hole pouring layer, it dried for 30 minutes at 85 \*\* under decompression. Next, 52.5 mg N-polyvinyl carbazole (PVK: 3.0 eV of the minimum excitation triplet energy), 22.5 mg of 2-(4,4'-biphenyl)-5-(4-tert-buthylphenyl)-oxadiazole (t-BuPBD: 2.9 eV of the minimum excitation triplet energy), And bis(2-phenyl pilus JINATO) (dimethyldithiocarbo eight) iridium (III) (illustration compound-A-1: 2.6 eV of the minimum excitation triplet energy) After dissolving 1.2 mg in 3.75 ml of toluene, Under argon atmosphere, the spin coat (100 nm in thickness after desiccation) of the solution filtered with a 0.5-micrometer filter was carried out on the substrate in which the PEDOT/PSS layer was formed, and it was made into the luminous layer. Next, this substrate was fixed to the substrate holder of a vacuum evaporator, it decompressed below to  $5 \times 10^{-4}$  Pa, BATOFENANTORORIN was vapor-deposited in thickness of 15 nm with the evaporation rate of 0.1nm/sec, and it was considered as the electron transport layer. LiF was vapor-deposited in thickness of 0.5 nm with the evaporation rate of 0.02nm/sec as an electronic injection layer, 150 nm of aluminum was vapor-deposited with the evaporation rate of 1.5nm/sec as the negative pole after this, and the organic EL device was produced. When this organic EL device was driven by a direct current, green ( $\lambda_{\text{max}} = 510 \text{ nm}$ ) luminescence equivalent to the phosphorescence spectrum of illustration compound-A-1 was obtained. When this element was driven by the constant current of  $50 \text{ mA cm}^{-2}$ , the luminosity reduction-by-half life was 60 hours.

[0144]The organic EL device was produced by the same method as Example 1 except having made into bis(2-phenyl pilus JINATO)(pyrrolidine 1 \*\*JICHIO carbo eight) iridium (III) (illustration compound-A-2: 2.6 eV of the minimum excitation triplet energy) the platinum metal

complex used for <Example 2> luminous layer. When this organic EL device was driven by a direct current, green ( $\lambda_{\text{max}} = 510 \text{ nm}$ ) luminescence equivalent to the phosphorescence spectrum of illustration compound-A-1 was obtained. When this element was driven by the constant current of  $50 \text{ mA cm}^{-2}$ , the luminosity reduction-by-half life was 50 hours.

[0145]The organic EL device was produced by the same method as Example 1 except having made into screw benzo keno REITO (dimethylamino dithiocarbonyl) iridium (III) (illustration compound B-1: 2.5 eV of the minimum excitation triplet energy) the platinum metal complex used for <Example 3> luminous layer. When this organic EL device was driven by a direct current, yellow ( $\lambda_{\text{max}} = 548 \text{ nm}$ ) luminescence equivalent to the phosphorescence spectrum of the illustration compound B-1 was obtained. When this element was driven by the constant current of  $50 \text{ mA cm}^{-2}$ , the luminosity reduction-by-half life was 45 hours.

[0146]After UV/O<sub>3</sub>-washing the glass substrate in which the <Example 4> ITO transparent electrode was patterned, it is fixed to the substrate holder of a vacuum evaporator, Below to  $5 \times 10^{-4} \text{ Pa}$ , decompress and m-MTDATA (N,N,N-tris-(3-(4-methylphenyl)phenyl)aminotriphenylamine), With the evaporation rate of 0.1 nm/sec, NPB (4,4'-bis[2,6-dimethylphenyl]-N,N'-diphenylbenzidine) was vapor-deposited in thickness of 30 nm and 10 nm, respectively, and was made into hole pouring and a hole transporting bed. Next, 20 nm of layers in which rubrene was contained by vapor codeposition 3% (mass percentage) in NPB and rubrene were laminated. Furthermore, 20 nm of layers in which illustration compound-A-1 was contained by vapor codeposition 6% (mass percentage) in CBP (4,4'-bis(N-carbazolyl)biphenyl: 2.9 eV of the minimum excitation triplet energy) and Ir complex (illustration compound-A-1: 2.6 eV of the minimum excitation triplet energy) are laminated, It was considered as the luminous layer. Then, BATOFENANTORON was vapor-deposited in thickness of 15 nm with the evaporation rate of 0.1 nm/sec, and it was considered as the electron transport layer. LiF was vapor-deposited in thickness of 0.5 nm in evaporation rate 0.02 nm/sec as an electronic injection layer, 150 nm of aluminum was vapor-deposited with the evaporation rate of 1.5 nm/sec as the negative pole after this, and the organic EL device was produced. When this organic EL device was driven by a direct current, yellow-green ( $\lambda_{\text{max}} = 510 \text{ nm}$ ) luminescence which each ingredient equivalent to the fluorescence spectrum of rubrene and the phosphorescence spectrum of illustration compound-A-1 mixed at a rate of 1:5 was obtained. When this element was driven by the constant current of  $50 \text{ mA cm}^{-2}$ , the luminosity reduction-by-half life was 100 hours.

[0147]The organic EL device was produced by the same method as Example 1 except having made into tris(2-(4-methylphenyl)pyridine) iridium (III) ( $\text{Ir}(\text{ppy})_3$ ) the platinum metal complex used for a <comparative example> luminous layer. When this organic EL device was driven by a direct

current, green ( $\lambda_{\text{max}} = 510 \text{ nm}$ ) luminescence equivalent to the phosphorescence spectrum of  $\text{Ir(ppy)}_3$  was obtained. When this element was driven by the constant current of  $50 \text{ mA cm}^{-2}$ , the luminosity reduction-by-half life was 5 hours.

[0148]

[Effect of the Invention]According to this invention, the alt.metal-ized metal complex (preferably platinum metal complex) which contains dithiocarboxylic acid thru/or its derivative as a ligand, Intersection between systems to an excitation triplet from an excitation singlet is performed efficiently, and since stability is very good, it can excel in the preservation and driving stability at the time of an elevated temperature, and the organic EL device which used this for the luminescent material has high luminous efficiency, and its current density dependency of luminous efficiency is small, and the life-span of [ it ] can be extended.

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[Translation done.]